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Fan et al.

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(54) **ELECTRICAL CONNECTOR**

(71) Applicant: **Unimicron Technology Corp.**, Taoyuan (TW)

(72) Inventors: **Chih-Peng Fan**, Taoyuan County (TW); **Yin-Hwa Cheng**, Taipei (TW); **Ching-Ho Hsieh**, Taoyuan County (TW); **Ling-Kai Su**, Taoyuan County (TW); **Yung-Hao Hsueh**, Taoyuan County (TW)

(73) Assignee: **Unimicron Technology Corp.**, Taoyuan (TW)

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(51) **Int. Cl.**

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H01R 12/71	(2011.01)
H05K 3/32	(2006.01)
H05K 3/40	(2006.01)

(52) **U.S. Cl.**

CPC ***H01R 12/718*** (2013.01); ***H05K 3/326*** (2013.01); ***H05K 3/4092*** (2013.01); *H01L 2924/15311* (2013.01); *H01L 2924/15313* (2013.01); *H05K 2201/0367* (2013.01);

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(58) **Field of Classification Search**

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USPC 439/82, 66, 81
See application file for complete search history.

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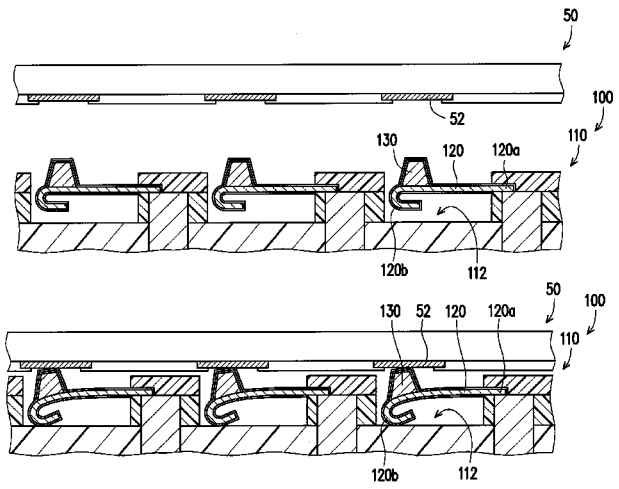
Primary Examiner — Neil Abrams
Assistant Examiner — Travis Chambers
(74) *Attorney, Agent, or Firm* — Jianq Chyun IP Office

(57) **ABSTRACT**

An electrical connector includes a base and an elastic terminal. The base has a recess. The elastic terminal is connected to the base and extends to the recess. The elastic terminal has a fixed end and a free end, the fixed end is connected to the base, and the free end is located at the recess and is curved. When the contact moves towards the recess, the contact is capable of pushing the contact protrusion to bend towards the bottom of the recess so that the free end leans against the bottom of the recess. The electrical connector may further include a contact protrusion connected to the elastic terminal. When the contact moves towards the recess, the contact is capable of pushing the contact protrusion to make the elastic terminal bend towards the bottom portion of the recess so that the free end leans against the bottom of the recess.

14 Claims, 10 Drawing Sheets



(52) **U.S. Cl.**
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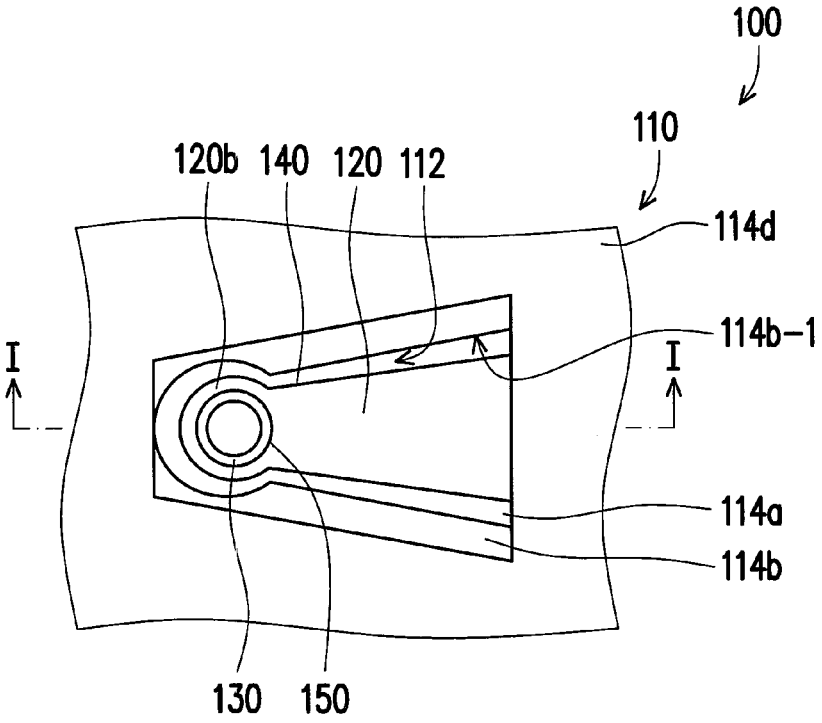
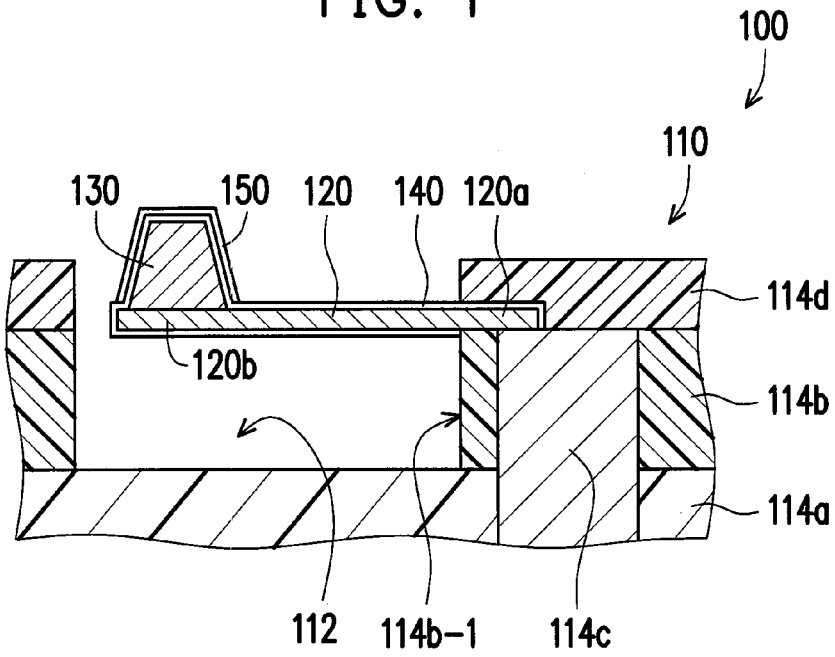

100
110
120b
140
120
112
114d
114b-1
I
I
114a
114b
130
150

FIG. 1


100
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114b
114a
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114b-1
114c

FIG. 2

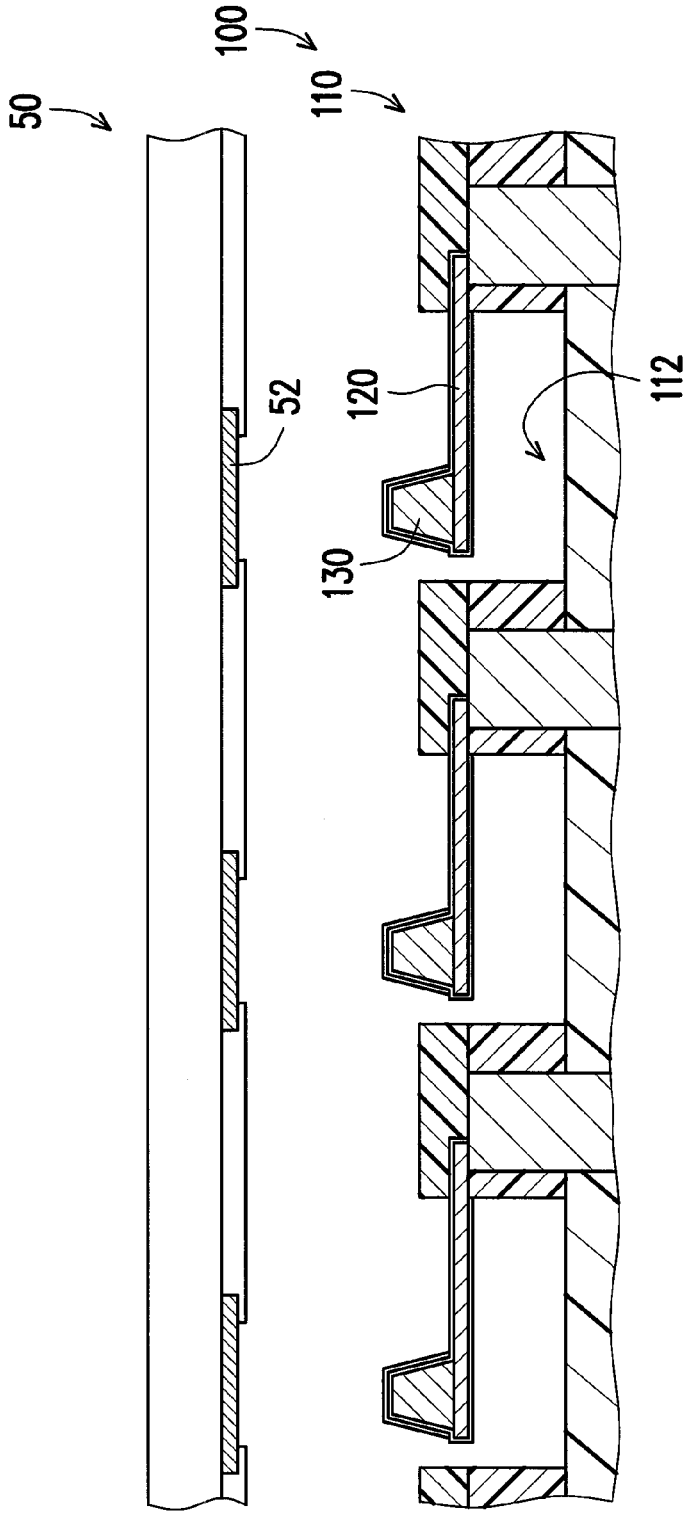

FIG. 3A

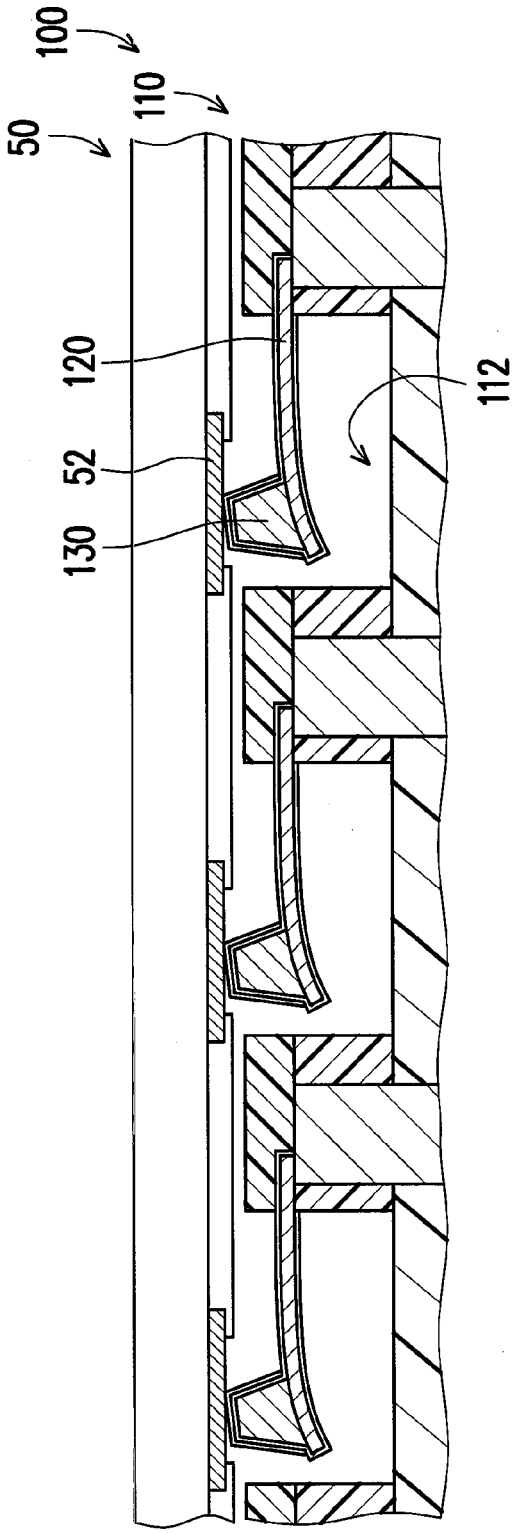

FIG. 3B

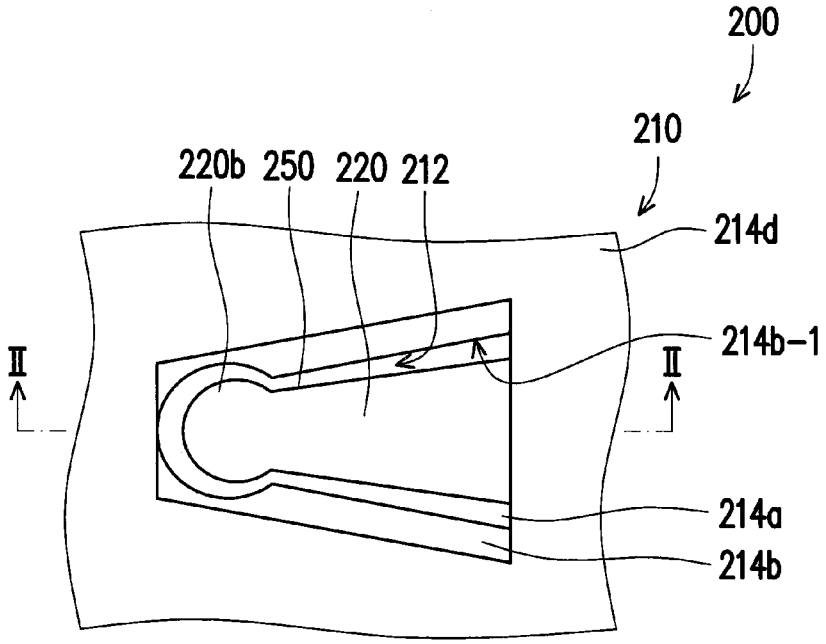
200
210
220b 250 220 212
214d
214b-1
II
II
214a
214b

FIG. 4

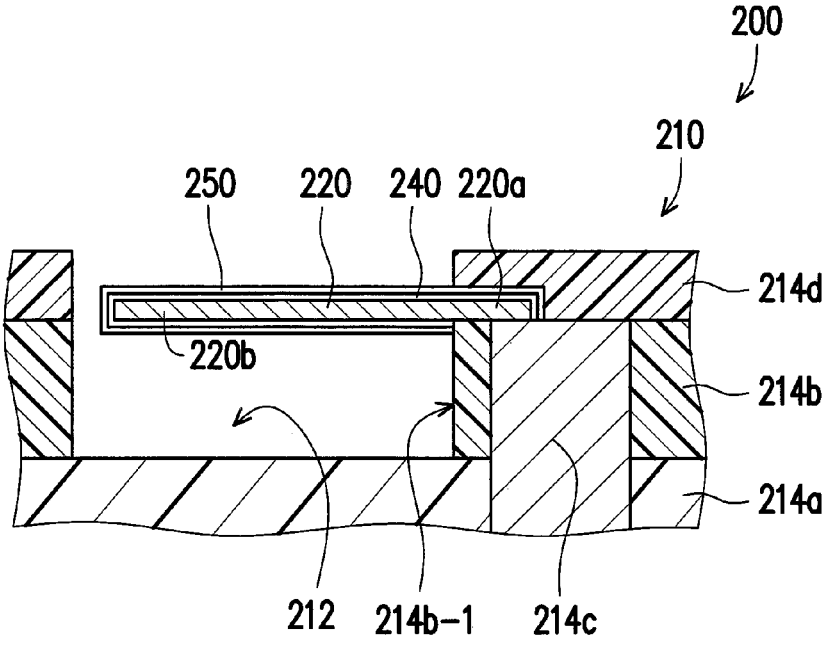
200
210
250 220 240 220a
214d
220b
214b
214a
212 214b-1 214c

FIG. 5

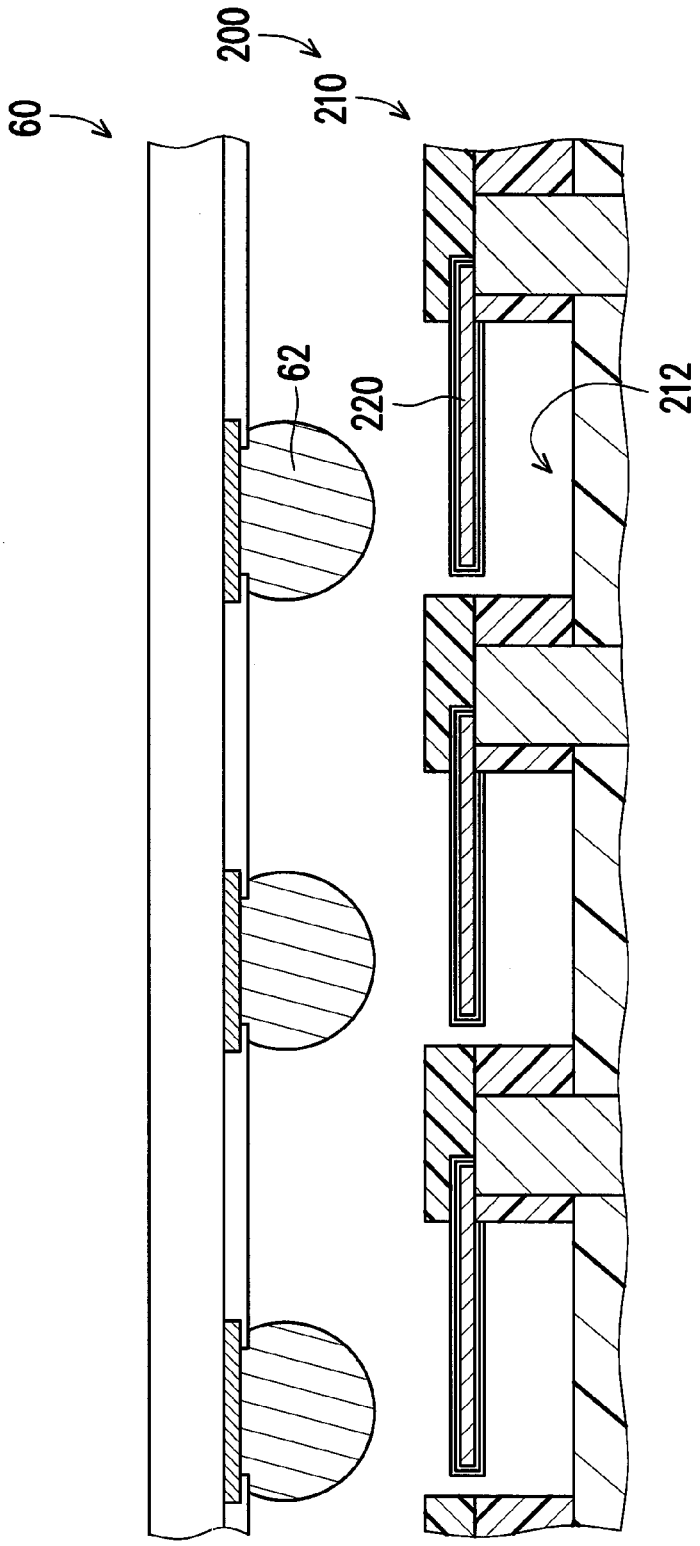

FIG. 6A

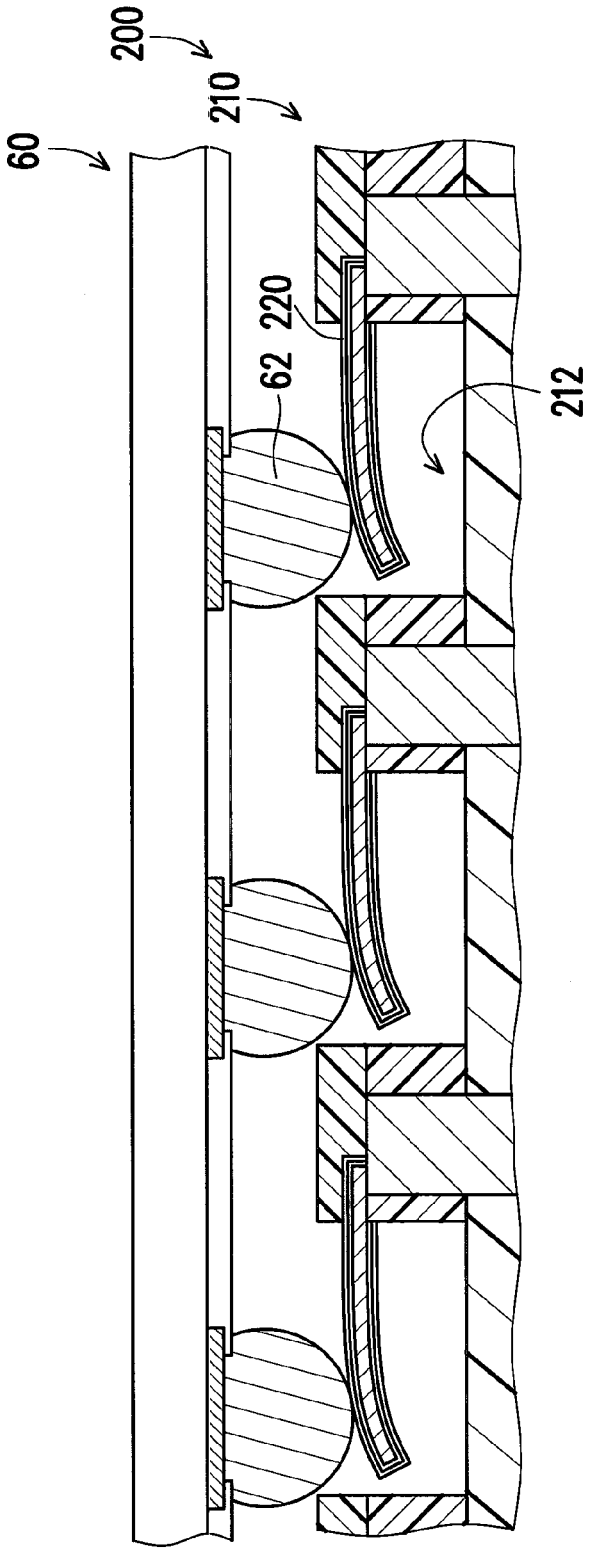

FIG. 6B

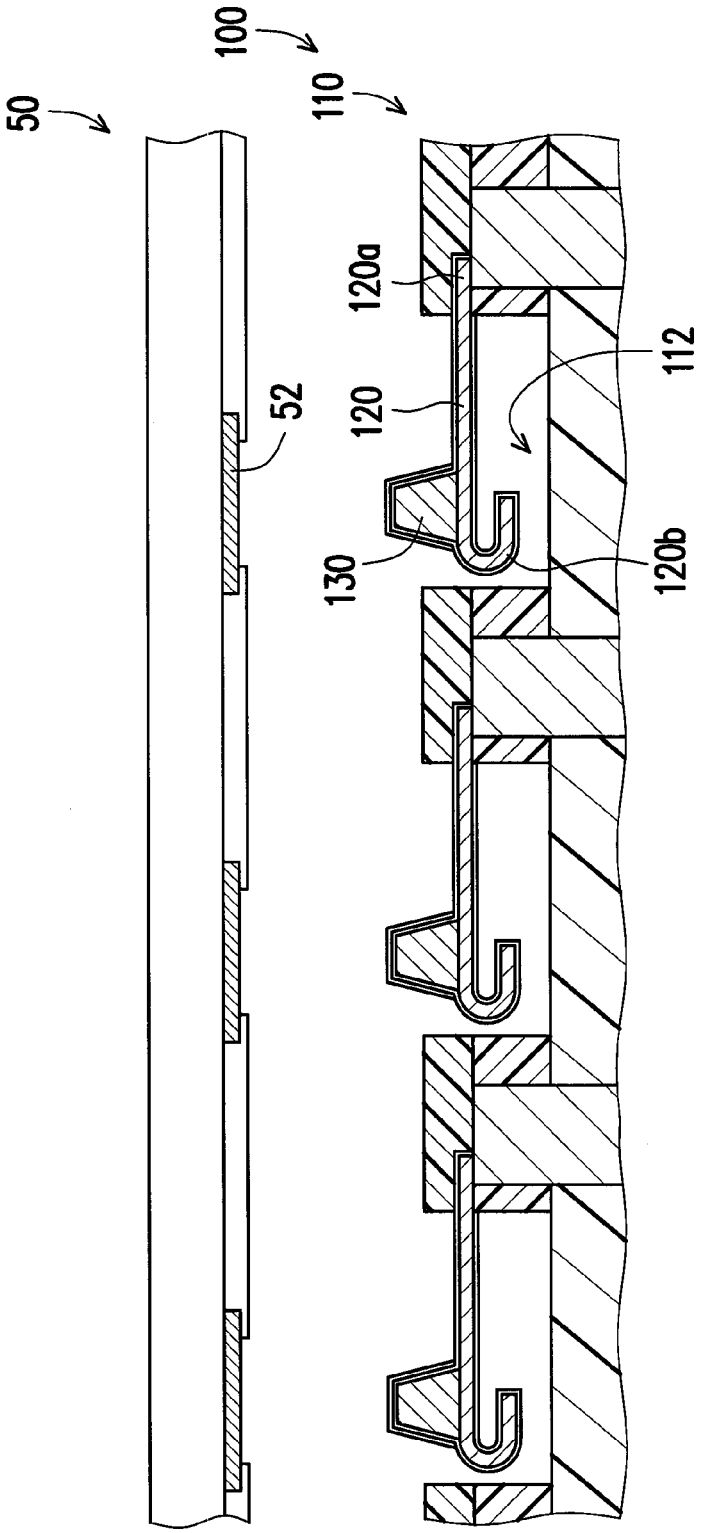

FIG. 7A

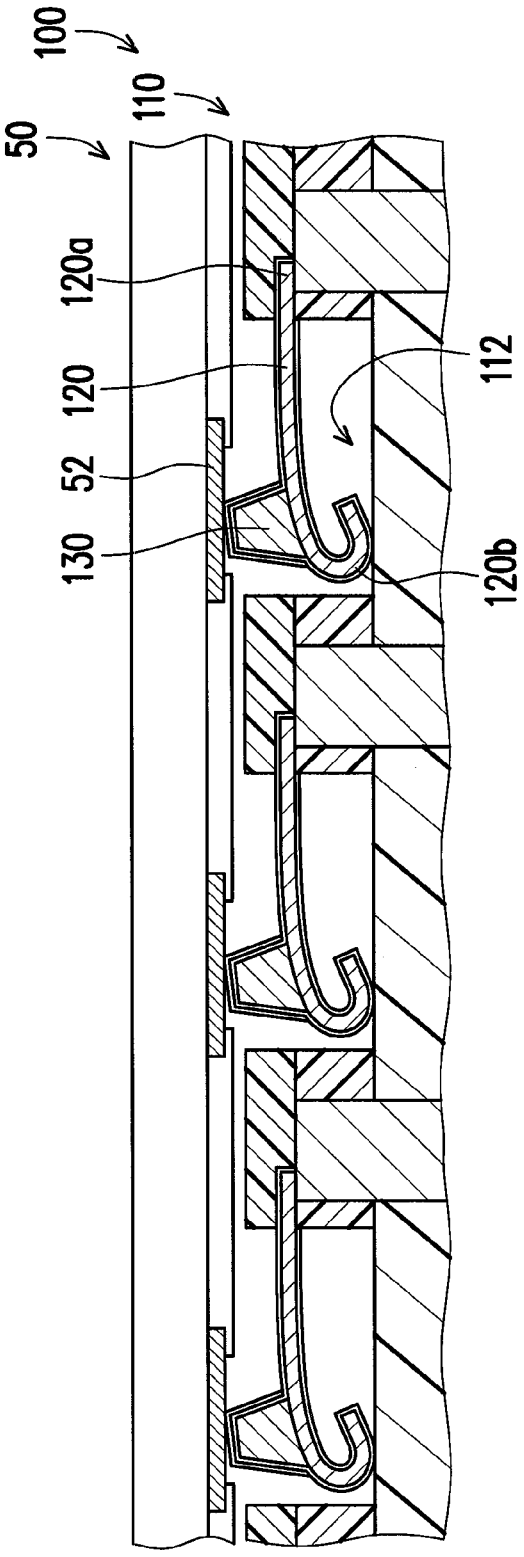

FIG. 7B

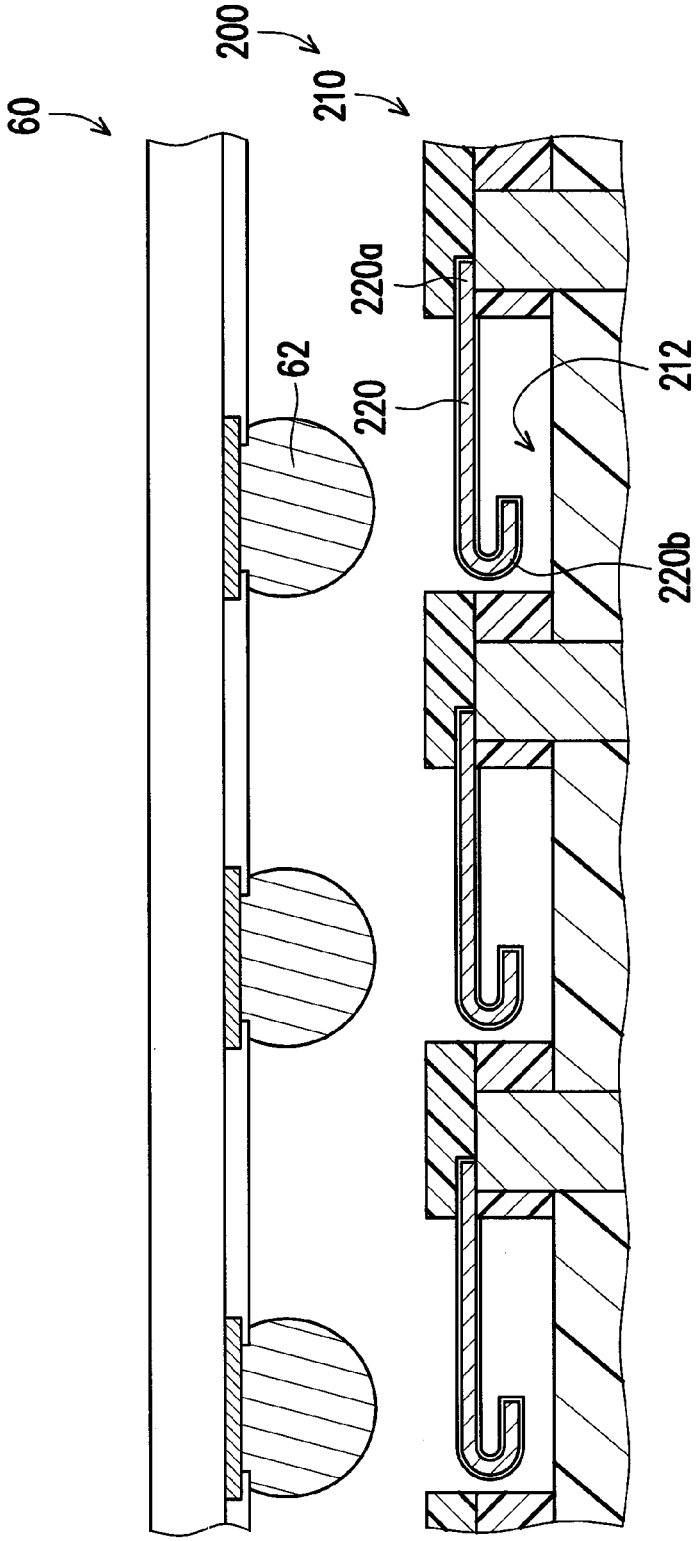

FIG. 8A

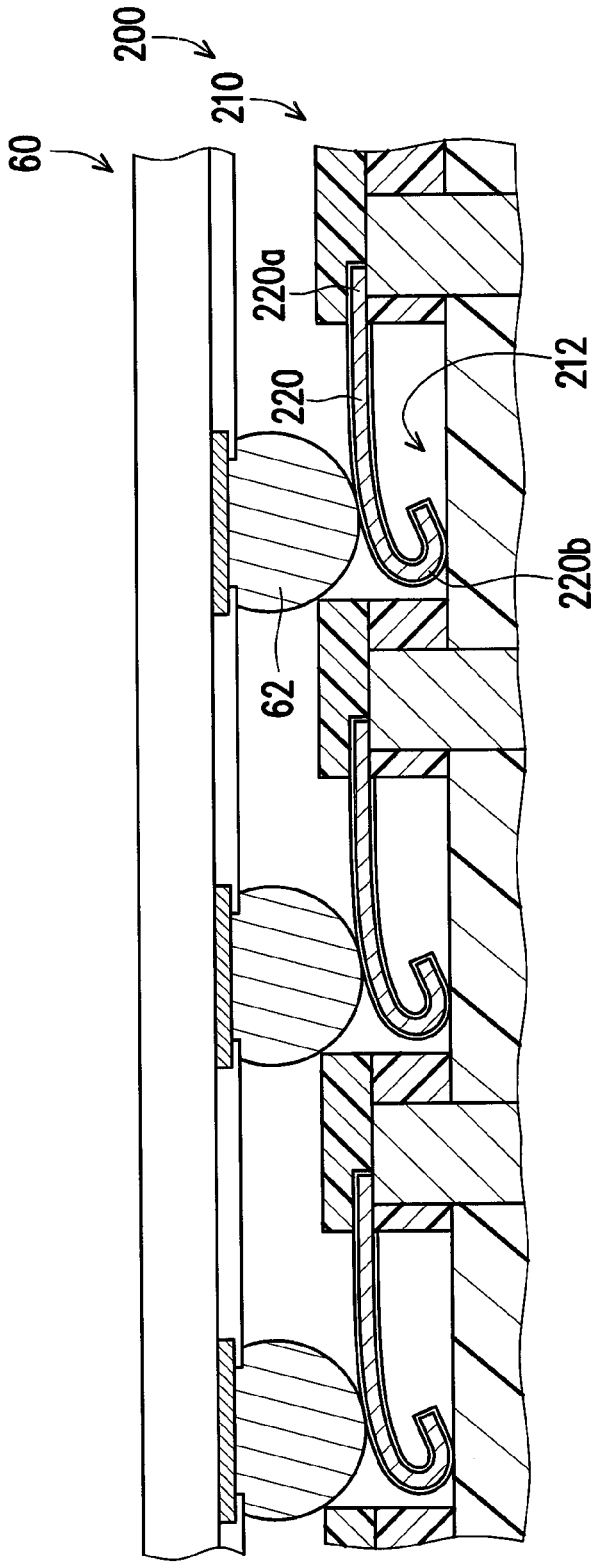

FIG. 8B

ELECTRICAL CONNECTOR

CROSS-REFERENCE TO RELATED APPLICATION

This application a continuation-in-part of and the priority benefit of U.S. application Ser. No. 13/934,238, filed on Jul. 3, 2013. The prior application Ser. No. 13/934,238 claims the priority benefit of Taiwan application serial no. 102116353, filed on May 8, 2013. The entirety of each of the above-mentioned patent applications is hereby incorporated by reference herein and made a part of this specification.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The invention generally relates to an electrical connector, and more particularly, to an electrical connector suitable for contacting contacts (such as flat contacts or the bump contacts).

2. Description of Related Art

Usually, an electrical connector is used for electrical connection between two electronic apparatuses for transmitting signals or supplying power. In the technical field of semiconductor chip packaging, a so-called land grid array (LGA) is a type of high-density contacts used in a circuit carrier, where a plurality of flat contact arrays are arranged on the bottom-surface of the circuit carrier, and the flat contacts can be electrically connected to each other via the internal circuit in the circuit carrier and the integrated circuit (IC) chip mounted on the top surface of the circuit carrier.

In order to mount an LGA-type circuit carrier to a circuit board, in the prior art, a plurality of upward-bent elastic terminals are disposed on a base so as to respectively contact a plurality of flat pads of the circuit carrier in downward moving to realize the electrical connection between the circuit carrier and the electrical connectors. To ensure the contact between the elastic terminals and the flat contacts, the elastic terminal must have a shape required by producing a certain elastic force and the end of the elastic terminal must have an arc shape for contacting the flat pad, and thus, the elastic terminal must be bent upwards by using a machining process.

SUMMARY OF THE INVENTION

Accordingly, the invention is directed to an electrical connector used to electrically contact a contact.

The invention provides an electrical connector suitable for contacting a contact and the electrical connector includes a base, an elastic terminal and a contact protrusion. The base has a recess. The elastic terminal is connected to the base and extends to the recess. The elastic terminal has a fixed end and a free end, the fixed end is connected to the base, and the free end is located at the recess and is curved. The contact protrusion is connected to the elastic terminal, in which when the contact moves towards the recess, the contact is capable of pushing the contact protrusion to make the elastic terminal bend towards the bottom portion of the recess so that the free end leans against the bottom of the recess.

The invention provides an electrical connector suitable for contacting a contact and the electrical connector includes a base and an elastic terminal. The base has a recess. The elastic terminal is connected to the base and extends to the recess. The elastic terminal has a fixed end and a free end, the fixed end is connected to the base, and the free end is located at the recess and is curved. When the contact moves towards the recess, the contact is capable of pushing the contact protrusion to bend towards the bottom portion of the recess so that the free end leans against the bottom of the recess.

Based on the depiction above, in the electrical connector of the invention, the recess is formed on the base and the elastic terminal may extend to the recess. Therefore, when the elastic terminal is pushed by the contact (for example, a bump contact), the elastic terminal is capable of bending towards the bottom of the recess, so that the elastic force produced by the elastic terminal after deformation can ensure the contacting between the elastic terminal and the corresponding contact. In addition, the electrical connector may further have a contact protrusion, which is disposed on the elastic terminal for contacting the contact (such as a flat contact or a bump contact). Moreover, the free end of the elastic terminal may be curved and have elasticity to increase the lifetime of the elastic terminal.

Other objectives, features and advantages of the present invention will be further understood from the further technological features disclosed by the embodiments of the present invention wherein there are shown and described preferred embodiments of this invention, simply by way of illustration of modes best suited to carry out the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a partial top view of an electrical connector according to an embodiment of the invention.

FIG. **2** is a cross-sectional view of the multiple electrical connectors taken along line I-I in FIG. **1**.

FIG. **3**A is a cross-sectional view of the electrical connectors as shown in FIG. **2** prior to contacting the flat contacts.

FIG. **3**B is a cross-sectional view of the electrical connectors as shown in FIG. **2** after contacting the flat contacts.

FIG. **4** is a partial top view of an electrical connector according to another embodiment of the invention.

FIG. **5** is a cross-sectional view of the multiple electrical connectors taken along line II-II in FIG. **4**.

FIG. **6**A is a cross-sectional view of the electrical connectors as shown in FIG. **2** prior to contacting the bump contacts.

FIG. **6**B is a cross-sectional view of the electrical connectors as shown in FIG. **2** after contacting the bump contacts.

FIG. **7**A is a cross-sectional view of an electrical connector prior to contacting the bump contacts according to another embodiment of the invention.

FIG. **7**B is a cross-sectional view of the electrical connectors as shown in FIG. **7**A after contacting the bump contacts.

FIG. **8**A is a cross-sectional view of an electrical connector prior to contacting the bump contacts according to another embodiment of the invention.

FIG. **8**B is a cross-sectional view of the electrical connectors as shown in FIG. **8**A after contacting the bump contacts.

DESCRIPTION OF THE EMBODIMENTS

FIG. **1** is a partial top view of an electrical connector according to an embodiment of the invention, and FIG. **2** is a cross-sectional view of the multiple electrical connectors taken along line I-I in FIG. **1**. Referring to FIGS. **1** and **2**, an electrical connector **100** of the embodiment is suitable for contacting one or multiple flat contacts (i.e., the flat contacts **52** of the circuit carrier **50** in FIG. **3**A). The electrical connector **100** includes a base **110**, one or multiple elastic terminals **120** and one or multiple contact protrusions **130**. The base **110** has one or multiple recesses **112**. Each of the elastic terminals **120** is connected to the base **110** and extends to a corresponding recess **112**. Each of the elastic terminals **120**

has elasticity and electrical conductivity. Each of the contact protrusions **130** is disposed on the corresponding elastic terminal **120**. In the embodiment, each of the elastic terminals **120** may horizontally extend to the corresponding recess **112**.

FIG. **3**A is a cross-sectional view of the electrical connectors as shown in FIG. **2** prior to contacting the flat contacts, and FIG. **3**B is a cross-sectional view of the electrical connectors as shown in FIG. **2** after contacting the flat contacts. Referring to FIGS. **3**A and **3**B, when the flat contacts **52** of the circuit carrier **50** move towards the recesses **112**, the flat contacts **52** can respectively push the contact protrusions **130** to make each of the elastic terminals **120** bend towards the bottom of the corresponding recess **112**. As a result, the elastic force produced by the elastic terminal **120** after deformation can ensure the contact between the elastic terminal **120** and the corresponding flat contact **52**.

Back to FIGS. **1** and **2**, in the embodiment, the base **110** may be a printed circuit board (PCB) and the material of the elastic terminals **120** may include copper. In more detail, the base **110** and the elastic terminals **120** may be fabricated through the conventional process for fabricating the PCB. Thus, the base **110** may include a core layer **114***a*, a dielectric layer **114***b*, one or multiple conductive pillars **114***c* and a cover layer **114***d*, in which an opening **114***b*-**1** of the dielectric layer **114***b* and the core layer **114***a* together form the recess **112**. The elastic terminals **120** are formed by using an etching process and an etching mask to pattern a copper layer (not shown) disposed on the dielectric layer **114***b*, or by punching a metallic foil, followed by laminating the metallic foils onto the dielectric layer **114***b*. Therefore, the thickness of the elastic terminals **120** may be smaller until 0.05 mm with a range between 0.01 mm and 0.2 mm. The thickness and the length of an elastic terminal **120** may be adjusted according to the required elastic force and the contacting area.

A fixed end **120***a* of the elastic terminal **120** is connected to the base **110**, and the conductive pillar **114***c* is connected to the fixed end **120***a* of the elastic terminal **120**. The cover layer **114***d* covers the dielectric layer **114***b* and the fixed ends **120***a* of the elastic terminals **120**. The elastic terminal **120** further has a free end **120***b* located at the recess **112**, while the contact protrusion **130** is located at the free end **120***b*. The contact protrusion **130** is higher than the cover layer **114***d* relatively to the recess **112**. It should be noted that the invention does not limit the process for fabricating the base **110** and the elastic terminals **120** to the above-mentioned PCB fabrication process. In fact, other processes may be used to fabricate the base **110** and the elastic terminals **120**.

Referring to FIGS. **1** and **2** again, in the embodiment, the electrical connector **100** further has a conductive layer **140** (for example, a nickel layer) disposed on the elastic terminals **120** and the corresponding contact protrusions **130**. When the flat contacts **52** and the contact protrusions **130** contact each other as shown in FIG. **3**A or **3**B, the flat contacts **52** are electrically connected to the elastic terminals **120** through the conductive layer **140** on the contact protrusions **130**. The contact protrusions **130** may be made of elastic material to have elasticity so as to ensure a good contact between the flat contacts **52** and the contact protrusions **130**. In addition, a protection layer **150** (for example, a gold layer) may be disposed on the conductive layer **140**, and the protection layer **150** is located at the contact protrusions **130** and at the area where the contact protrusions **130** contact the flat contacts **52** to increase the durability. In another embodiment, when the material of the contact protrusions **130** is conductive so that the flat contacts **52** in FIG. **3**A or **3**B may be electrically connected to the elastic terminals **120**, the conductive layer **140** may be saved.

The above-mentioned embodiment is applied for contacting between the elastic terminals and the flat contacts, but the idea in the embodiment may be also applied for contacting between the elastic terminals and the bump contacts referring to the other embodiment in the following.

FIG. **4** is a partial top view of an electrical connector according to another embodiment of the invention, and FIG. **5** is a cross-sectional view of the multiple electrical connectors taken along line II-II in FIG. **4**. Referring to FIGS. **4** and **5**, an electrical connector **200** of the embodiment is suitable for contacting one or multiple bump contacts (i.e., the bump contacts **62** of the circuit carrier **60** in FIG. **6**A). The shape of the bump contacts herein is, for example, spherical shape, cylindrical shape or conical shape. The electrical connector **200** includes a base **210** and one or multiple elastic terminals **220**. The base **210** has one or multiple recesses **212**. Each of the elastic terminals **220** is connected to the base **210** and extends to a corresponding recess **212**. Each of the elastic terminals **220** has elasticity and electrical conductivity. In the embodiment, each of the elastic terminals **220** may horizontally extend to the corresponding recess **212**.

FIG. **6**A is a cross-sectional view of the electrical connectors as shown in FIG. **2** prior to contacting the bump contacts, and FIG. **6**B is a cross-sectional view of the electrical connectors as shown in FIG. **2** after contacting the bump contacts. Referring to FIGS. **6**A and **6**B, when the bump contacts **62** of the circuit carrier **60** move towards the recesses **212**, the bump contacts **62** can respectively push the elastic terminals **220** to make each of the elastic terminals **220** bend towards the bottom of the corresponding recess **212**. As a result, the elastic force produced by the elastic terminal **220** after deformation can ensure the contacting between the elastic terminal **220** and the corresponding bump contact **62**.

Referring to FIGS. **4** and **5**, in the embodiment, the base **210** may be a printed circuit board (PCB) and the material of the elastic terminals **220** may include copper. In more detail, the base **210** and the elastic terminals **220** may be fabricated through the conventional process for fabricating the PCB. Thus, the base **210** may include a core layer **214***a*, a dielectric layer **214***b*, one or multiple conductive pillars **214***c* and a cover layer **214***d*, in which an opening **214***b*-**1** of the dielectric layer **214***b* and the core layer **214***a* together form the recess **212**. The elastic terminals **220** are formed by using an etching process and an etching mask to pattern a copper layer (not shown) disposed on the dielectric layer **214***b*, or by punching the metallic foil, followed by laminating the metallic foils onto the dielectric layer **214***b*. Therefore, the thickness of the elastic terminals **220** may be smaller until 0.05 mm with a range between 0.01 mm and 0.2 mm. The thickness and the length of an elastic terminal **220** may be adjusted according to the required elastic force and the contacting area.

A fixed end **220***a* of the elastic terminal **220** is connected to the base **210**, and the conductive pillar **214***c* is connected to the fixed end **220***a* of the elastic terminal **220**. The cover layer **214***d* covers the dielectric layer **214***b* and the fixed ends **220***a* of the elastic terminals **220**. The elastic terminal **220** further has a free end **220***b* located at the recess **212**. In addition, the electrical connector **200** in the embodiment further has a conductive layer **240** (for example, a nickel layer) and a protection layer **250** (for example, a gold layer) disposed on the elastic terminals **220** to increase the durability. The conductive layer **240** is helpful for the protection layer **250** to be adhered onto the elastic terminals **220**. In another embodiment (not shown), it may be to dispose the protection layer **250** only and the conductive layer **240** is saved. It should be noted that the invention does not limit the process for fabricating the base **210** and the elastic terminals **220** to the above-

mentioned PCB fabrication process. In fact, other processes may be used to fabricate the base **210** and the elastic terminals **220**.

FIG. **7**A is a cross-sectional view of an electrical connector prior to contacting the bump contacts according to another embodiment of the invention, and FIG. **7**B is a cross-sectional view of the electrical connectors as shown in FIG. **7**A after contacting the bump contacts. Referring to FIGS. **7**A and **7**B, in comparison to the embodiments of FIGS. **3**A and **3**B, the free end **120***b* of the elastic terminal **120** of the embodiment is further curved, and is, for example, U-shaped, V-shaped, or other shapes having elasticity. Therefore, when the flat contacts **52** move towards the recess **112**, the flat contacts **52** can push the elastic terminal **120** to bend towards the bottom of the recess **112** so that the free end **120***b* leans against the bottom of the recess **112**, as shown in FIG. **7**B. In the embodiment, the curved free end **120***b* itself may have elasticity, and therefore the lifetime of the elastic terminal. **120** may be increased.

FIG. **8**A is a cross-sectional view of an electrical connector prior to contacting the bump contacts according to another embodiment of the invention, and FIG. **8**B is a cross-sectional view of the electrical connectors as shown in FIG. **8**A after contacting the bump contacts. Referring to FIGS. **8**A and **8**B, in comparison to the embodiments of FIGS. **6**A and **6**B, the free end **220***b* of the elastic terminal **220** of the embodiment is further curved, and is, for example, U-shaped, V-shaped, or other shapes having elasticity. Therefore, when the bump contacts **62** move towards the recess **212**, the bump contacts **62** can push the elastic terminal **220** to bend towards the bottom of the recess **212** so that the free end **220***b* leans against the bottom of the recess **212**, as shown in FIG. **8**B. In the embodiment, the curved free end **220***b* itself may have elasticity, and therefore the lifetime of the elastic terminal **220** may be increased.

In summary, in the electrical connector of the invention, the recess is formed on the base and the elastic terminal may extend to the recess. Therefore, when the elastic terminal is pushed by the contact (for example, a bump contact), the elastic terminal is capable of bending towards the bottom of the recess, so that the elastic force produced by the elastic terminal after deformation can ensure the contacting between the elastic terminal and the corresponding contact. In addition, the electrical connector may further have a contact protrusion, which is disposed on the elastic terminal for contacting the contact (such as a flat contact or a bump contact). Moreover, the free end of the elastic terminal may be curved and have elasticity to increase the lifetime of the elastic terminal.

It will be apparent to those skilled in the art that the descriptions above are several preferred embodiments of the invention only, which does not limit the implementing range of the invention. Various modifications and variations can be made to the structure of the invention without departing from the scope or spirit of the invention. The claim scope of the invention is defined by the claims hereinafter.

What is claimed is:

1. An electrical connector, suitable for contacting a contact and comprising:

a base, having a recess;

an elastic terminal, connected to the base and extending to the recess, wherein the elastic terminal has a fixed end and a free end, the fixed end is connected to the base, and the free end is located at the recess and is curved; and

a contact protrusion, connected to the elastic terminal and located at the free end, wherein when the contact moves towards the recess, the contact is capable of pushing the elastic terminal to bend towards a bottom surface of the recess so that the free end leans against the bottom surface of the recess.

2. The electrical connector as claimed in claim **1**, wherein the free end is U-shaped or V-shaped.

3. The electrical connector as claimed in claim **1**, wherein the base further comprises a cover layer, the contact protrusion is higher than the cover layer relatively to the recess, the contact is a flat contact, and when the flat contact moves towards the recess, the flat contact is capable of pushing the contact protrusion to make the elastic terminal bend towards the bottom of the recess.

4. The electrical connector as claimed in claim **1**, wherein the base further comprises a cover layer, the contact protrusion is lower than the cover layer relatively to the recess, the contact is a bump contact, and when the bump contact moves towards the recess, the bump contact is capable of pushing the contact protrusion to make the elastic terminal bend towards the bottom of the recess.

5. The electrical connector as claimed in claim **1**, wherein the base is a printed circuit board (PCB), and material of the elastic terminal includes copper.

6. The electrical connector as claimed in claim **1**, wherein the contact protrusion has electrical conductivity.

7. The electrical connector as claimed in claim **1**, further comprising:

a conductive layer, disposed on the elastic terminal and the contact protrusion.

8. The electrical connector as claimed in claim **7**, further comprising:

a protection layer, disposed on the conductive layer and located at the contact protrusion and at an area where the contact protrusion contacts the flat contact.

9. The electrical connector as claimed in claim **7**, wherein the contact protrusion has elasticity.

10. An electrical connector, suitable for contacting a contact and comprising:

a base, having a recess; and

an elastic terminal, connected to the base and extending to the recess, wherein the elastic terminal has a fixed end and a free end, the fixed end is connected to the base, and the free end is located at the recess and is curved, and when the contact moves towards the recess, the contact is capable of pushing the elastic terminal to bend towards a bottom surface of the recess so that the free end leans against the bottom surface of the recess.

11. The electrical connector as claimed in claim **10**, wherein the free end is U-shaped or V-shaped.

12. The electrical connector as claimed in claim **10**, wherein the contact is a bump contact, and when the bump contact moves towards the recess, the bump contact is capable of pushing the elastic terminal to bend towards the bottom of the recess.

13. The electrical connector as claimed in claim **10**, wherein the base is a printed circuit board (PCB), and material of the elastic terminal includes copper.

14. The electrical connector as claimed in claim **10**, further comprising:

a protection layer, disposed on the elastic terminal.

* * * * *